The huge crater, or *penumbra*, in which these spots, or *umbræ*, were situated, was the largest that I remember to have seen, and far larger than that which occurred in October 1865, which was mentioned then in the *Notices* of the R.A.S. by the Rev. F. Howlett and myself, and which was especially interesting on account of the extreme rapidity of the photospheric changes.

November 15.—The spot now visible on the Sun is an immense size. The *penumbra* is of an irregular oval shape, and measures across its major axis 128″, equal to 56,000 miles; while its minor axis measures 116″, or 51,000 miles. The *umbra* is most irregular in shape, measuring in its greatest length 39,000 miles, and its greatest breadth 23,000 miles. The changes in its outline are very rapid, so much so that it is most difficult to sketch, in addition to which the low altitude of the Sun and correspondingly bad definition render it increasingly difficult. The *umbra* has six large and long promontories stretching more or less across it, something like the fingers of the hand, only that they are curvilinear. The rugged glacier-like form of the sides of the *penumbra* is most remarkable, but the atmosphere is too bad to make measurements of details.

Clouds prevented further observation for some days.

November 19.—The great spot has greatly altered in its details. There is now a nest of *umbræ* within the one *penumbra*, which has not materially altered in shape, though it is enlarged, its greater length now being 64,000 miles, and its breadth 52,000 miles. The extreme activity of the photosphere continues, and is far greater than what I have ever noticed before. Within three hours two of the larger *umbræ* had joined themselves together, and had again separated. The channel of communication between them that was opened and again filled up was roughly estimated at about 2,000 miles wide and 8,000 or 9,000 miles long.

The extremely bad definition and the unsteadiness of atmosphere render it impossible to observe or measure the small details, while the excessively cloudy weather prevents anything more than occasional views of the Sun, otherwise this spot would have formed a study of surpassing interest.

The instrument employed was an Equatorial of $8\frac{1}{2}$ in. aperture by Cooke & Sons.

The Spectrum of the Great Sun-spot of 1882, *November* 12–25, *observed at the Royal Observatory, Greenwich.*

(*Communicated by the Astronomer Royal.*)

The spectrum of this remarkable spot was examined by means of the "half-prism" spectroscope on three occasions, viz., Nov. 18, 20, and 21. The weather in each instance was very unfavourable for a satisfactory examination, being misty and cloudy on Nov. 18 and 20, and on Nov. 21 the Sun was only visible

through a yellow fog. A detailed examination of any but the most conspicuous lines was therefore out of the question.

Nov. $17^d\ 23^h$–$18^d\ 1^h$.—The following lines were observed to be reversed, *i.e.*, bright instead of dark over the principal nucleus of the spot:—C, D_1, D_2, D_3, and F. Of these, C and F were exceedingly bright, particularly F; and this, notwithstanding that the mist enfeebled the blue and violet portions of the spectrum. D_3 was only perceived for a short time, apparently when the mist was lightest, about $23^h\ 50^m$. D_1 and D_2 were not only reversed but extravagantly broadened, each line forming a very broad and ill-defined dark band, quite 6 tenthmetres in breadth, with a sharp, narrow, bright line in the centre, apparently at the normal place of the line. This appearance, and the reversal of D_3, were noticed whenever the definition and light were a little better than usual. The reversal of C and F took place over the bright tongue, which all but divided the largest nucleus of the spot into two nearly equal portions. The reversal of the sodium lines was not noticed at the point where C and F were brightest.

The third and fourth lines of hydrogen could not be detected, but the mist made it impossible to observe the extreme ends of the spectrum.

The *b* lines and 1474 K showed no appreciable change. The strong calcium lines between C and D were doubled in breadth. The E lines were less strongly affected, and were perhaps one-third as broad again as usual.

The *general* absorption of the spot was small: that is, the continuous spectrum was not so much fainter than that of the general disk as might have been expected.

Nov. $19^d\ 23^h$–$20^d\ 0^h$.—The *general* absorption was more marked than on Nov. 18, and more lines were noticed to be broadened. The general absorption was not, however, uniform; here and there, there were broad, ill-defined patches, noticeably darker than the rest of the spectrum. The district lying between λ 4900 and λ 4830 was one of the most marked of these.

The C line was seen reversed right across the great nucleus; D_3 and F were suspected to be reversed, but, owing to the mist, could not be clearly seen as bright lines. D_1 and D_2 also could not be seen as bright lines, but they presented exactly the same appearance as they had done on Nov. 18, at times when the mist was too dense to permit the reversal to be clearly seen. That is, they were very much broadened, were very ill-defined, and much fainter than usual in the middle. Several other lines, amongst them λ 4957, λ 4920, and λ 4918, closely resembled the D lines. The 1474 K line did not appear to be affected, but one near it, either λ 5301 or λ 5307,—there was not time to properly identify the line, but it was believed to be λ 5307,—vanished over the spot.

The calcium and iron lines between C and D were much broadened, and also those near λ 5600 and λ 5856. These were broader by about two-thirds; the E lines were broader by about

one-half, the *b* lines by one-quarter. All these lines were, as a rule, well-defined, that is to say, they did not show the "smudged" appearance seen in the D lines, and the three iron lines near F, mentioned above.

The foregoing observations, both on Nov. 18 and 20, were all made with the "half-prism" spectroscope reversed, that is, with the instrument arranged as for observation of the prominences, so as to give great purity. Two "half-prisms" were employed. The spectroscope was afterwards placed in the direct position, as used for observation of stellar spectra, and only one "half-prism" was employed. With this dispersion, a remarkable reversion of the F line was noticed. At the preceding edge of the great nucleus, there was a broad bright flame, which, touching the F line at the extreme preceding edge of the nucleus, sloped away from the nucleus in the preceding direction, and from the F line towards the blue. It was inclined to the F line at an angle of about 40°, was 1 or perhaps $1\frac{1}{4}$ tenthmetre in average breadth, and extended to a distance from the F line of 3 or perhaps $3\frac{1}{2}$ tenthmetres. It was pointed at each end, and was nearly but not quite straight, being a little twisted near its centre. A displacement of $3\frac{1}{2}$ tenthmetres towards the blue would correspond to a motion of approach of 134 miles per second. Time of observation Nov. $19^{d}\ 23^{h}\ 20^{m}$.

Nov. 21.—The sun was only seen through fog and was very faint. The spot-spectrum was therefore a dense black band in which it was very difficult to perceive any details. The "half-prism" spectroscope reversed, with two "half-prisms," was used throughout the morning. The C and F lines were reversed over the greater portion of the area of the spot, not, however, over the very darkest part of the principal nucleus, but over all its fainter portions. D_3 and perhaps 1474 K seemed to be reversed over the same region. The latter line seemed to be displaced nearly 1 tenthmetre towards the red. The D lines together covered quite 10 tenthmetres, and ran one into the other; they were very ill-defined, and appeared exactly as on Nov. 20. They extended further towards the blue than towards the red, in fact, the broadening seemed traceable twice as far in the first direction as in the second. A very large percentage of the lines between D and F had a similar appearance to that shown by the D lines and the iron lines near F on Nov. 20; *i.e.*, they were very much broader than on the general disk, were very ill-defined, and were much fainter than the corresponding lines on the Sun, especially about their centres. It is, therefore, probable that a clearer day would have shown them as distinctly reversed, especially as the F line showed precisely the same "smudged" appearance whenever the fog became too thick for it to be seen as a bright line.

Group *a* and the lines at λ 6200 were very much broadened, principally on the side nearer the blue.

A momentary gleam of clearer sunlight showed F reversed in the most intricate and beautiful manner right across the great

nucleus—not over its entire area, but at short intervals from one side to the other, even over its blackest portion. These stars of brilliant blue light were on the average about twice as broad as the dark F line on the general disk, sometimes four times as broad, and were but little displaced, if at all.

The observations were made by Mr. Maunder throughout.

Royal Observatory, Greenwich:
1883, *Jan.* 12.

Spectroscopic Results for the Motions of Stars in the Line of Sight, obtained at the Royal Observatory, Greenwich, in the Year 1882. No. VI.

(*Communicated by the Astronomer Royal.*)

The results here given are in continuation of those printed in the *Monthly Notices*, vol. xxxvi. p. 318, vol. xxxvii. p. 22, vol. xxxviii. p. 493, vol. xli. p. 109, and vol. xlii. p. 230. The observations were made with the "half-prism" spectroscope, one "half-prism" with a dispersion of about $18\frac{1}{2}°$ from A to H being used. An eyepiece with a magnifying power of 14 was employed throughout.

Up to 1882, March 13, a convex cylindrical lens, with its axis parallel to the length of the spectrum, and placed in the view-telescope within the focus, and a concave or Barlow lens of 2 inches focus placed in the collimator between the slit and the object-glass, as used throughout the year 1881, were employed. On March 14, the Barlow lens was removed, and the cylindrical lens was placed in front of the slit, as in the observations made previously to 1881. In most of the observations a diaphragm coated with Balmain's luminous paint has been used in the micrometer-adapter to give a phosphorescent illumination of the field.

The observations of the Moon and of the sky spectrum have been made as a check on the general accuracy of the results.

Motions of Stars in the Line of Sight, in Miles per Second, observed with the Half-prism Spectroscope.

(+ denotes Recession; − Approach.)

The initials M. and N. are those of Mr. Maunder and Mr. Nash respectively.

Date.	No. Obs.	Line.	Meas.	Earth's Motion in M. per sec.	Concluded Motion of Stars. Meas.	Estimd.	Remarks.
				β Cassiopeiæ.			
1882.							
July 24	M	2	F	−11·2	+34·1	+33·9	Clouds constantly passing. Observation unsatisfactory.